



## INNOVATING PHYSICS EDUCATION WITH THE ARCHIO APPLICATION TO ENHANCE INTEREST IN LEARNING ARCHIMEDES' LAW

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The main problem in physics education among students is the lack of interest in learning due to monotonous teaching methods such as lectures. Lectures are often considered uninteresting and ineffective. This research aims to assess the effectiveness of a Thunkable-based application named Archio in increasing learning interest. The study uses the 4-D development model (Define, Design, Develop, Disseminate) and was conducted at the end of 2023. The Define stage involved a survey to identify students' learning difficulties, which showed Archimedes' Law as the most difficult material. The Archio application was then designed (Design) and developed (Develop) with features such as learning materials, interactive simulations, quizzes, and reflections. At the Disseminate stage, the application was introduced through posters. The application received scores of 4.30 and 4.20 from expert and student validation results. The validation results indicated that the application is suitable for use in a very good category. The recommendation from this research is a further development of the Archio application based on validator feedback to ensure its wider and smoother usage.

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## INTRODUCTION

In today's era of globalization, technology is rapidly advancing and permeating every aspect of human life and all fields. Education, as a sector inseparable from technology, plays a crucial role. High-quality human resources capable of competing in development require education. The shift in educational paradigms from traditional to information technology is a global demand. This unavoidable shift significantly impacts the education sector. Information and Communication Technology (ICT) can enhance the efficiency and effectiveness of education. The rapid pace of scientific and technological development necessitates education to utilize technology as a means to innovate in learning [1]. The use of ICT in education enables broader and faster access to diverse information and learning materials while also supporting a more interactive and engaging learning process.

Educational media can assist teachers in delivering information to students or vice versa. One of the components that supports the success of the learning process [2]. The use of instructional media in the learning process greatly facilitates effective teaching and communication. By selecting appropriate instructional media, educators can assist students in achieving learning objectives more

effectively and make learning more interactive, efficient, and enjoyable. It's noted that much of our knowledge is derived from 75% visual input, 13% auditory input, and the remaining 12% from taste, smell, and touch [3].

Science education such as physics. Physics education often faces hurdles due to its abstract concepts, which students find difficult to grasp. Learning physics requires a deeper understanding as it involves numerous illustrations, symbols, and equations in its learning process [4]. Conventional learning methods often struggle to effectively illustrate abstract natural phenomena and phenomena, while monotonous teaching methods can lead to waning student interest. Research conducted by Sipahutar *et al.* (2023) indicates that the use of instructional media can enhance student interest in learning [5].

Based on research conducted by Nugraha and Warliani (2022) regarding students' learning difficulties in physics, it was found that students indeed face learning challenges. Evidenced by high percentages of indicators: 74.19% struggle to understand the material, 87.1% are unable to answer when asked by the teacher, and 83.87% find it difficult to comprehend example problems. One of the factors influencing these learning difficulties is the teaching delivery method by the teachers [6]. Printed books contain lengthy readings or explanations with complex concepts, making it difficult for students to comprehend what is written inside.

Previous studies also indicate that engaging instructional media can enhance students' learning motivation. Utami *et al.* (2023) found that one-way teachers can increase students' learning motivation is by implementing engaging and enjoyable instructional media. Supported by diagram representations showing a significant increase in students' learning motivation, amounting to 37.14% from the pre-learning cycle [7]. Furthermore, research conducted by Umar *et al.* (2023) found that instructional media have a significant and positive influence of 92.4% on students' learning interests [8].

One potential instructional media is an Android-based application developed using Thinkable, which allows for rapid and effective development of educational apps [9]. However, there is currently limited research specifically investigating the effectiveness of Thinkable-based educational media applications, especially in the context of physics education with engaging designs like comics. Therefore, this study focuses on the development and evaluation of a Thinkable-based educational media application designed in comic format for physics content related to Archimedes' principle. This application, named Archio, is designed to enhance student motivation and interest through interactive features such as learning materials, simulations, interactive quizzes, and reflection-based pallets.

Previous studies have demonstrated the positive impact of using technology-based instructional media. Rahmatullah and Purwanti (2021) indicated that learning aided by Android-based applications using Thinkable significantly improves students' learning interests [10]. Graceillia and Setiana (2021) found that Thinkable applications run smoothly and help students better understand the learning materials [11]. Furthermore, research by Khotimah *et al.* (2023) shows that educational media applications integrating local wisdom and featuring videos, simulations, and images can enhance students' learning attention despite requiring an internet connection [2].

The main difference between this study and previous research lies in the design of the educational media application in comic format. The Archio application includes interactive quizzes that require students to answer correctly before proceeding to the next question, along with reflection-based Padlet features. This research aims to make a significant contribution to the field of physics education, particularly in enhancing student motivation and interest through the use of innovative Thinkable-based instructional media applications.

This study aims to assess the effectiveness of using the Archio application in enhancing student motivation and interest in physics learning. Additionally, the research seeks to compare the outcomes of using the Archio application with other Thinkable-based instructional media that feature different designs and functionalities. The study endeavors to identify the strengths and potential of the Archio application in making the physics learning process more engaging and effective for students. Through this research, innovative solutions are expected to be identified that can improve the quality of physics education and make a significant contribution to the field of education.

## RESEARCH METHODS

The development of this application uses a qualitative method with a 4-D model approach, which consists of the stages of Define, Design, Develop, and Disseminate. The selection of this approach is based on its advantages in time efficiency, allowing the application development to be completed within two months. This research was carried out at the end of 2023. At the end of the development process, the app was validated by three validators with backgrounds as teachers and lecturers in physics, who contributed to assessing and providing feedback for the app. The following is a breakdown of each stage in the 4-D approach.



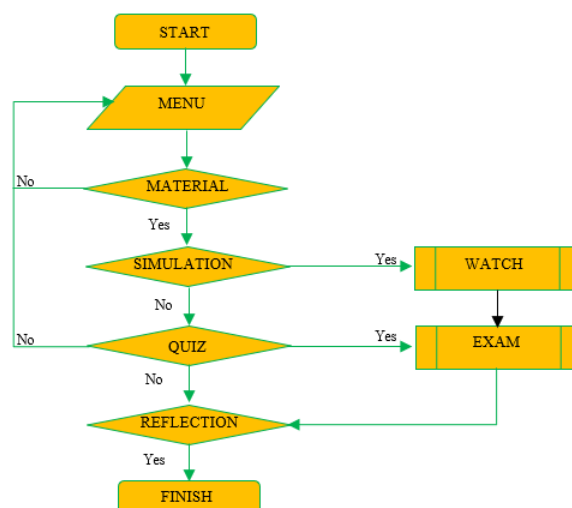
**Figure 1.** 4-D Model Stages [12]

### 1. Defining Stage

At this early stage, the research began with a survey using a questionnaire. The questionnaire was given to students who had completed the Basic Physics course, aiming to identify the difficulties they faced in understanding the material. The surveyed materials include 1) the Law of Thermodynamics, 2) Archimedes' Law, 3) Heat, 4) Dynamic Electricity, and 5) Newton's Laws. From the survey, it is known that Archimedes' Law is the most difficult material to understand. Based on these findings, the development of a learning application titled Archio is focused on facilitating the understanding of Archimedes' law. The app is developed using Thinkable to facilitate this learning.

### 2. Design or Planning Stage

The design stage is aimed at implementing the concept into the application to be created. This process includes finding references and designing an app that is easy to develop and user-friendly. Thinkable was chosen as the development platform because it allows the creation of applications with simple and intuitive programming. Thinkable was also chosen because it has not been widely used for the development of physics learning materials, especially Archimedes' law. The following flowchart illustrates the Archio app development system.



**Figure 2.** System of using the Archio application

### 3. Develop stage

This stage involves iterative development and revision of the application. Starting from determining the flow of use to developing features in the application. The Archio app is designed to explain the concept of Archimedes' law through interactive stories in the form of

comics that illustrate common misconceptions related to the principles of sinking, floating, and floating objects in the water. After the material is presented, users can access video simulations that support the visualization of Archimedes' law concept, followed by an interactive quiz. If users answer incorrectly, they cannot proceed to the next question. The materials and quiz came from the book "Physics for Scientists and Engineers" by Randall D. Knight, and the supporting images were designed using Canva.

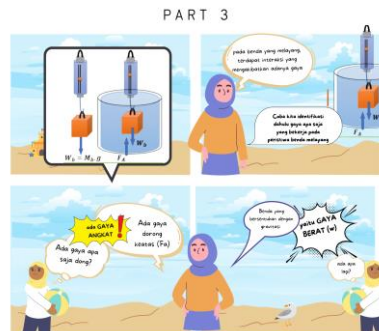


Figure 3. Archio app material display

4. Disseminate Stage

The Archio app is equipped with various features such as learning objectives, materials, simulations, quizzes, and reflections. Archio app user reflection uses a padlet platform that can be monitored directly by all users. This application not only provides in-depth material explanations with interesting narratives but is also supported by simulation videos that help visualize the concept of Archimedes' law. The category of achievement level of respondents from the expert assessment questionnaire can be seen in Table 1

Table 1. Assessment Criteria[13]

No	Persentase	Category
1	4.20 < average ≤ 5.00	Very good
2	3.40 < average ≤ 4.20	Good
3	2.60 < average ≤ 3.40	Good enough
4	1.80 < average ≤ 2.60	Not so good
5	1.00 < average ≤ 1.80	Not very good

The app has been validated by three validators with professional backgrounds in physics, who gave ratings on a scale of 1-5. For the dissemination stage, Archio was introduced to the public through a poster containing information and the main features of the application.



Figure 4. Archio app poster

## RESULT AND DISCUSSION

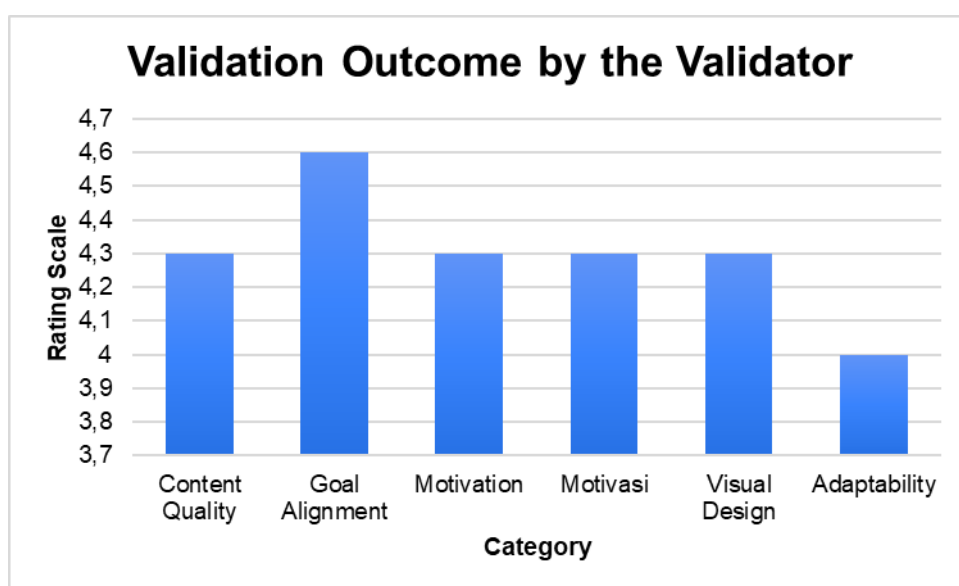
Learning interest can influence learning outcomes [14]. The use of lecturing techniques can create an educational experience that is tiresome and boring for students, reducing their ability to engage with the learning material actively in class [15]. Students may quickly become unfocused, fatigued, and disengaged from illustrations if educators solely rely on lecturing techniques, potentially affecting their interest in learning [16].

The use of innovative and engaging instructional media becomes crucial in addressing these issues, as it can ignite new desires and interests while boosting learning motivation [17]. One application that can be used as an instructional media is Thinkable, enabling the creation of interactive learning apps like Archio. Archio serves as the primary media in this study and is designed to assist students in learning physics concepts, specifically focusing on Archimedes' principle. The selection of Archimedes' principle as the topic is based on survey results indicating it has the highest difficulty percentage among other topics, as shown in Table 2.

**Table 2.** Survey Results on Learning Difficulties

Physics Material	Percentage of Difficulty
Laws of Thermodynamics	45%
Archimedes' Principle	78%
Heat	52%
Dynamic Electricity	63%
Newton's Laws	58%

This application is designed in an interactive format, featuring comic-style materials, video simulations to visualize concepts after reading the materials, and interactive quizzes that cannot be skipped if answered incorrectly. This design encourages students to think critically. Another feature is a reflection using Padlet, a collaborative tool that allows students to reflect on and evaluate what they have learned, as well as share thoughts that can be accessed and interacted with in real-time. Before students test the application, it has already undergone validation by experts. The testing process of the Archio application begins with students downloading the app and following the provided learning flow. Subsequently, students assess the application's suitability. The validation results obtained from both experts and students are as follows.



**Figure 5.** Expert Validation Results

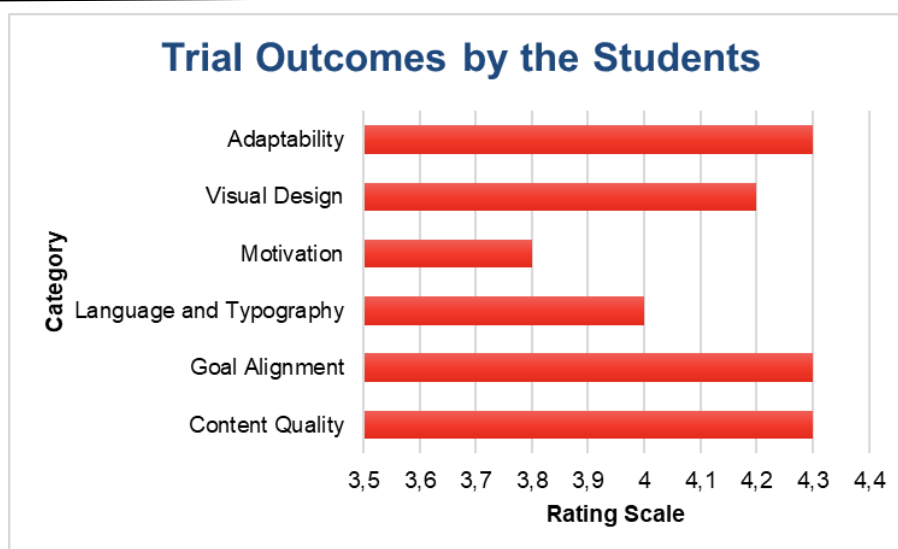


Figure 6. Validation Results of Student Trials

Based on the validation results, Archio has proven to be suitable for use as an instructional medium. The average ratings from both validators and students were 4.30 (excellent category) and 4.20 (good category), respectively. These scores indicate that Archio has been well-designed. Validators suggested that Archio is suitable for use with some revisions according to their feedback. The use of the Archio application in physics education allows for the integration of technology, facilitating interactive learning and deeper conceptual understanding, thereby aiding students in comprehending complex material more easily. Archio enhances students' learning interest through innovative interactive and visual features, stimulating curiosity and motivation to delve deeper into the study of physics.

Based on the assessment results from students who were sampled for the trial use of Archio as an instructional media, it was found that the majority of students rated the quality of the content presented as excellent. Archio has been designed in accordance with the learning objectives, enabling students to use this media effectively. Students who accessed Archio stated that it was engaging as a learning tool. Those who participated in the trial recommended Archio to their peers. Positive feedback from students included praise for the attractive design that enhanced their learning interest and for the clear and engaging presentation of the material, making it easier for them to understand.

Some students encountered difficulties downloading Archio on their devices due to compatibility issues. Additionally, a few students who successfully downloaded the instructional media reported issues with opening the application. Overall, despite these technical challenges that need to be addressed, Archio received positive feedback from other students who tried it and was considered suitable for use as an instructional medium.

## CONCLUSIONS

The research conducted shows that the Archio application is designed to help students learn physics concepts from Archimedes material. The application received a very good category from experts and students who conducted trials. Thus, the application can be used as a learning media that can increase interest in learning. Archio can be an innovative solution that can improve the quality of physics learning. Archio has great potential, but this application has not been commercialized and is not yet available on the Play Store, so access to use is still limited. Further development is expected so that the application can be disseminated to the public. Several important improvements need to be implemented to enhance the quality of the Archio app moving forward.

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